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(Reaffirmed 2003)

CODE OF PRACTICE FOR INSTALLATION AND MAINTENANCE OF AERODROME LIGHTING FITTINGS

PART 2 MAINTENANCE

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Indian Standard

CODE OF PRACTICE FOR INSTALLATION AND MAINTENANCE OF AERODROME LIGHTING FITTINGS

PART 2 MAINTENANCE

0. FOREWORD

0.1 This Indian Standard (Part 2) was adopted by the Bureau of Indian Standards on 29 February 1988, after the draft finalized by the Illuminating Engineering and Luminaires Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Aerodrome lighting fittings are provided as marker lights to give visual guidance to the pilot. These lighting fittings may be elevated type for installation on ground or on suitable support, or inset type for installation in pavement. This code covers good engineering practices for the installation and maintenance of both these types of fittings.

0.3 This code of practice has been prepared in the following two parts:

Part 1 Installation, and

Part 2 Maintenance.

1. SCOPE

1.1 This code of practice covers the guidance for maintenance of airport lighting fittings and their associated control and distribution equipment.

1.1.1 This code of practice does not cover the maintenance of electric substation and generating sets feeding the aviation ground lighting (AGL) system.

2. NEED FOR A HIGH STANDARD OF MAINTENANCE

2.1 However carefully designed and installed, no installation will give a good service unless special care is taken in their subsequent maintenance. The precautions taken during initial installation regarding alignment, water-tightness, etc, have to be continued during maintenance operations to ensure reliability of the lighting systems. A high degree of reliability and safety is required out of these systems since they provide a positive visual guidance to aircrafts in poor visibility conditions. The unserviceability of ground light fittings may lead to costly diversion of aircrafts or to serious accidents, etc. The ground lighting facilities, therefore, call for a high standard of maintenance and adoption of a systematic maintenance programme.

3. NATURE OF MAINTENANCE ACTIVITY

3.1 Although the quantum of maintenance activities and the organization, there for, may vary from airport to airport depending on the various factors, such as the lighting systems provided, type of equipment, frequency of operation of aircraft, availability of second runway, climatic conditions, etc. The nature of maintenance activity is the same irrespective of the size and development of the airports. The maintenance activities may be of routine preventive nature, whereby the performance, minor adjustments, etc, are checked for the components of the system to avoid interruptions to the facilities, or be of a nature of repair and overhaul called breakdown maintenance. Activities of preventive maintenance to be carried out are grouped as daily, weekly, monthly, etc, and may need minor changes in periodicities in some airports depending upon the prevailing conditions.

4. AIDS TO EFFICIENT MAINTENANCE

4.1 The various factors which contribute to efficient and high standard of maintenance are indicated below.

4.2 Record of Installations Maintained — Up-to-date drawings showing location of all lights, pipe crossings, cable runs, control circuits and wiring diagram of each piece of equipment, layout of power supply arrangement, etc, shall be kept handy. One copy of each should be permanently fixed to the wall of the contractor panel room or centralized control position and one copy be kept separately with a cloth pasted behind for field use. The locations of cable joints must also be clearly indicated. Entries should also be made about any additions and alterations to the installations.

4.3 Manufacturer's Maintenance Manual and Instructions — The technical literature, operation and maintenance manuals, wiring diagram of control equipment, etc, for the installed equipments and test equipments shall be kept up by the maintenance personnel. Maintenance schedules laid down by the manufacturers shall be strictly adopted. The information in this standard shall supplement the same.

4.4 Personnel — The maintenance operations shall be carried out only by qualified persons with adequate knowledge of the equipments and the systems. Periodical training should be arranged to the maintenance personnel.

4.5 Safety Procedures — Since the AGL systems are high voltage installations, all standard procedures and practices applicable to high voltage installations shall be followed.

Repair and replacement activities at site on cables, regulators, etc, shall be done only after switching off the supply and displaying near the supply, a caution notice against accidental switching on of the supply. Before a cable work involving testing and cuttings is started, the cable must be earthed first using an insulated earthing handle. All safety procedures shall be strictly observed [*see* IS : 5216 (Part 1)-1982*].

4.6 Maintenance in Operational Areas — No maintenance activity in the operational area shall be carried out without prior permission of the control tower personnel. The maintenance personnel should be fully conversant with the procedures prescribed in individual airports, like flag or light indication from the tower, etc, for working in the operational areas.

One should be watchful and alert while working in the operational areas so as not to cause hinderance to the aircraft operations. The maintenance vehicles should be parked well outside the pavements at not less than 10 m from the edge light, while working in the field.

Whenever any digging work is done in operational areas, all concerned authorities should be consulted before commencing the work. Adequate precaution should be taken to ensure that existing power and communication cables encountered enroute are not disturbed.

4.7 Equipment for Maintenance — To properly maintain and effect quick repairs on airport lighting systems, the following items must be available with the maintenance personnel:

a) Split core type ammeter,

b) Multimeter,

c) Megger,

d) Earth megger,

e) Test lamp,

f) Manually operated pump,

g) Petromax light,

h) Levelling/siting device for VASI installations,

j) Equipments and materials for cable jointing, and

k) 'Men working' and other necessary Caution Boards.

4.8 Tools and Plant for Maintenance — The following equipments and tools should preferably be available which help in enhancing the efficiency and standard of maintenance:

a) A vehicle,

b) Bipper or short range portable trans-receiver for issue to tradesmen for issuing instructions while in field or *vice-versa*,

c) Cable fault locator,

d) A small trolly mounted generating set of 1·5 kW for field lighting and carrying out minor welding work/soldering work, and

e) Torque tightening tool (pneumatic or electric).

4.9 Spare Parts — In view of the operational requirement of the installation, an adequate stock of spare parts should be built up in every airport sufficient for proper maintenance. The number and types of spares required would depend on many factors like the make and type of equipment, life of installation, operation density of the airport and hence the hours of operation of the lighting systems, climate, etc. Keeping the above factors in view, the requirements of spares should be planned in advance, by a proper study of the consumption of the various items of spares in the previous years. Particular attention is necessary in respect of fast moving items of spare parts like grease, tapes, gaskets, jointing materials, carbon tetrachloride, glass cleansing agent, etc.

The storage of all spare parts should be in a good condition and the spares should be easily accessible to authorized persons at times of need.

4.10 Preventive Maintenance Schedules

4.10.1 Preventive maintenance schedule shall be planned in advance and executed systematically. Recommended schedule is indicated in **6**.

4.10.2 The preventive maintenance checks should be carried out during day time when the visibility is good so that any defects noticed are rectified before sunset.

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*Recommendations of safety procedures and practices in electrical work: Part 1 General (*first revision*).

4.10.3 *Record of Maintenance* — Constant improvement in the quality of maintenance and reliability of equipment would be possible only with a proper record of maintenance activity. Record of periodical maintenance, namely. daily, weekly, etc, checks as typically shown in Appendix A, shall be maintained.

A register should be maintained for each component of the system, namely, lamp, CCRs, cables fittings, etc, wherein details should be periodically recorded to provide the following information (*see* Appendix B for typical format):

a) Replacements/repairs made (details, cost, reason for failure, etc);
b) Premature failure (the probable causes);
c) Maintenance problems (nature, cause, etc, of faults); and
d) Performance of particular makes of equipment and cables.

Annual review of the register shall be made to provide future guidance to the maintenance engineers.

5. PREVENTIVE MAINTENANCE REQUIREMENTS

5.1 The important points to be checked up during inspection of ground lighting facilities are briefly enumerated below for the various components of the system.

5.2 Elevated Light Fitting — The elevated fitting consist of hardware including frangible coupling, sockets, lamp and lens, with or without colour filter, day marking cone, etc. The hardware needs to be painted to prevent corrosion and numbered annually for ease of maintenance. The condition of gaskets, tightness of fixing bolts and stiffness in lens clips, etc, should be checked. Sometimes the fixing bolts may get sheared. In such cases, a fresh hole is drilled and tapped to the next higher size for fixing the fitting. Such bolts may be painted with a different colour to distinguish from the standard size adopted in other fittings. Occasionally, the lens and filters may get broken due to blast-propelled stones, hail-storm, sudden temperature changes (hot-filters and lens chilled by sudden cold rain), etc. These must be replaced immediately. The lens and filters may get dirty due to dust, bird-falls or exhaust blasts and should be kept clean so as not to reduce the light output. Fused lamps should be immediately replaced. The fitting as a whole should remain in proper alignment with reference to the pavement and in level to give the light output in desired angles. Growth of grass around the fittings should be checked, as it would otherwise obscure the light output from the fittings.

In case of VASI units, the system should be flight checked, after reinstallation in case of their accidental displacement due to any cause. As such, vehicle drivers should be warned to keep away from the unit to avoid damage or disturbance to their alignment.

5.3 Isolating Transformers and Cables — The condition of insulation should be checked by megger test periodically. Cable joints and terminations should be inspected to ensure their reliable service. Absorption of moisture into the sheating of the cable should be checked, near the terminal ends, especially for polychloroprene (neoprene) cables, by looking for any abnormal bluges. The CI transformers housing boxes should be kept dry using manually operated pumps, if necessary, and a special attention is needed in pre-monsoon and post-monsoon season in this regard. Two essential precautions in keeping the system water tight are:

a) A special grease is applied to the mating ends of connectors before jointing. Further HT sealing tape should be applied over the jointed connectors, applying sufficient pull on the tapes.
b) The gasket below the fitting should be checked whenever the fitting is removed and replaced, if necessary.

5.4 Constant Current Regulators — The regulators can be of resonant type moving coil type, thyrister type or magnetic amplifier type. Particular attention is needed in checking the oil leakages, oil insulation values and oil level in the case of oil-filled regulators. All moving parts should be lubricated periodically. Condition of input, output and control terminals/ connectors, lightning arrestor (where provided), operation of relays (including overload and open circuit relays) and contactors in the unit for free action, and positive closing of contacts and their condition are the most essential items of check in a regulator. Fused lamps in back indication circuit must be replaced immediately.

5.5 Earthing — The earth resistance and earth continuity should be checked periodically and the results recorded.

6. PREVENTIVE MAINTENANCE CHECKS

6.1 Daily Checks

6.1.1 *Light Fittings*

6.1.1.1 With the circuit charged, look for burnt out lamps and record observations for necessary replacements. Replace such lamps before sunset. Record in the replacement register. Check for the fixtures out of alignment. Record the fixtures locations and correct at the earliest possible.

NOTE 1 — Sometimes a lamp's failure to light up may be due to loose seating of the lamp in the holder or short-circuit in the isolating transformer, or its secondary leads or earth fault on both sides of the fittings.

NOTE 2 — The burnout of all lamps in a circuit should also occur due to an abnormal power surge. Check the regulator for the overload cut-off operation in such cases.

NOTE 3 — In case of premature lamp burnouts, output current of CCR may be checked and remedial measures taken.

NOTE 4 — Check lamp socket and electrical contact for pitting before replacing the lamp. Clean contacts with carbon tetrachloride or liquid ammonia, if necessary. (Do not apply sand paper.) Visually examine the condition of the lens gasket, while re-lamping.

NOTE 5 — In the case of VASI installations, the complete lamp assembly should be taken out of the unit if there is a lamp failure and should be replaced with a prealigned unit from the store. The removal and replacement of fused lamp should be done according to manufacturer's recommendations. The connecting wires should be checked at the time of lamp replacement. Extreme caution should be taken to align the lamp properly and the cover should be closed only thereafter.

6.1.1.2 *Check for dimly burning lamps* — Lamps should burn dim due to ageing or due to earth leakages in the fitting, transformer or cable. Verify the life of the lamp from the previous reclamping date from the replacement register. Replace the lamp, if necessary. Rectify the fault if it lies beyond the lamp and this may not need lamp replacement. Portions of lights in a circuit may burn dim or may not burn at all due to low circuit insulation resistance to ground at more than one location. Locate the ground fault and correct the fault or replace cable as required.

6.1.1.3 Visually examine the light fixtures for any damages that is knocked or displaced fitting, or broken lens, replace or rectify as may be required. If lens is broken, remove the glass pieces from site.

6.1.1.4 *Additional check for fittings for monsoon*

a) Visually check for evidence of lightning strikes and replace damaged parts immediately after rains or thunder storm.

b) Dry out water that might have been trapped inside the transformer housing box and paint the box with insulating varnish.

c) Check for grass, dirt and weeds around lighting units. Vegetation should not block the Pilot's view of the light.

6.1.1.5 *Additional check for new VASI* — Make daily checks of the approach angle of VASI installation in accordance with the manufacturer's instructions in new installation to ensure stabilization of the system. After stabilization is assured, this check could be done weekly. Keep a record of all angular settings made to the VASI system together with dates on which such settings were made. Check that there is no obstruction in the light path.

6.1.2 *Constant Current Regulators*

6.1.2.1 Clean the regulator externally, after switching off the supply.

6.1.2.2 Switch on the circuits, in turn, to check proper functioning of the regulators including a noiseless operation.

6.1.2.3 Check the regulator for operation of all steps of brightness on remote control.

6.2 Weekly Checks

6.2.1 *Light Fittings*

6.2.1.1 Check and clean dirty lenses externally with duster. Look for any crack in the lens or filter.

6.2.1.2 Check clips/screws holding the lens, correct/replace as may be required.

6.2.1.3 Check for vegetation obscuring lights and remove them. Preferably stabilize the area round the light unit to prevent such growth.

6.2.2 *Additional Check for VASI Units*

6.2.2.1 Check aiming angle with aiming device after the stabilization of the system.

6.3 Monthly Checks

6.3.1 *Light Fittings*

6.3.1.1 Check base plate bolts and tighten, if required.

6.3.1.2 Air-borne inspection of the entire lighting system should be carried out, wherever possible.

6.3.1.3 Check for proper alignment and orientation of light fittings and lenses, clean fixtures and sockets, as required.

6.3.2 *Additional Checks for VASI Unit*

6.3.2.1 Check mechanical parts for cleanliness and structural defects such as chipping, cracking, bending and serviceability of threads.

6.3.2.2 Check for damage done by aircrafts and take corrective action.

6.3.2.3 Inspect units for checking the conditions of plugs, sockets and connections, replace/renew as may be necessary.

6.3.2.4 Check for any water leakages and insect infestations.

6.3.2.5 Clean optical surfaces like lamps, filters and speaker glasses with suitable cleaning agent.

6.3.2.6 Check levelling and operation of tilt switch.

6.3.3 *Constant Current Regulators*

6.3.3.1 Check input voltage and current. If they are not within designed voltage limits, take corrective actions.

6.3.3.2 In the case of oil-filled regulators, check oil level and oil leakage, top up, if necessary.

6.3.3.3 Check the regulator load. Ensure that load does not exceed given kw rating of the regulator.

6.3.3.4 Check contactor panel for any abnormalities for heating, chattering, etc.

6.3.3.5 Check the operation through all stages of brightness using local control. Check output current on each brightness step. Compare results with the tolerances for them. Consult manufacturer's instructions book.

6.3.4 *Underground Cables*

6.3.4.1 De-energize the regulator, disconnect the cable leads at regulator and connect one lead of the megger 2 500 V to the cable and the other lead to earth. Megger reading thus obtained should be recorded. Check such readings by comparing with initial values. If these reveal progressive deteriorations or faults, corrective steps, including replacing cable pieces, where required, should be taken promptly.

6.4 Quarterly Checks

6.4.1 *Light Fittings*

6.4.1.1 Remove the light fixtures from the base and check the transformer housing box for presence of water which might have entered due to defective water tightening arrangement. Bale out water and replace fitting gasket, if deteriorated. Grease base plate bolts and refix the light fixture. Particular care should be taken for positioning the lens correctly.

6.4.1.2 Check connection of plugs and sockets with isolating transformer leads. Renew the old tapes.

6.4.1.3 In order to maintain maximum efficiency of light units, lenses and filters should be removed and washed with a suitable cleaning agent, and refixed in position.

NOTE — When the cleaning liquid is used, care should be taken so that the liquid does not drop on the gasket and the glass is thoroughly dried before fixing.

VASI—Check integrity of obstacle free approach which should not be obstructed from tree growth, new towers, pole lines or other obstacles.

6.4.2 *Control Panel* — Check the control panel for loose component and connections.

6.4.3 *Underground Cables*

6.4.3.1 Disconnect the cable sections on both ends of every run and check insulation resistance of the cable to earth with megger.

6.4.3.2 In the case of feeder cables, check, in addition, the insulation resistance between the two cables using a megger.

6.4.3.3 Visually examine the cable ends for any moisture entry within the sheathing (with moisture entering the cable end, it will be observed to have swollen or blistered).

6.4.3.4 Check each circuit for any single earth fault.

6.4.3.5 Check proper earthing of cast iron box by conducting an earth test with megger.

6.5 Half-Yearly Checks

6.5.1 *Light Fittings*

6.5.1.1 Clean units inside and outside paint, if necessary.

6.5.1.2 Realign, check all electrical connections.

6.5.1.3 Check angle of elevation of approach lights.

6.5.1.4 Check structure for integrity of approach lights.

6.5.1.5 Check approach area for any new obstruction of approach light.

6.5.2 *Constant Current Regulators*

6.5.2.1 Check the contacts of contactors/rotary switches on control panel for pitting or burning. Clean, if necessary, the contacts with liquid ammonia or carbon tetrachloride. Lubricate the bearings, if any.

6.5.2.2 Check the relays and contactors for proper functioning.

6.5.2.3 Check the relay rocker arms for movement and spring tension.

6.5.2.4 Check electrical and mechanical interlocks, if any, in CCR unit for proper functioning.

6.5.2.5 Check all the wirings and terminations.

6.5.2.6 Check the open circuit protection device for proper functioning by creating an open circuit on load side with circuit charged. Clean and adjust dashpots.

6.5.2.7 With load disconnected, energize the regulator once and watch the open circuit protector to see that it de-energizes the regulator within 2 or 3 seconds.

6.5.2.8 Test the earthing of CCRs.

6.5.3 *Underground Cables*

6.5.3.1 Check insulation resistance of underground cables.

6.5.3.2 Open manholes, pump out any trapped water and clean.

6.5.3.3 Megger all control circuits and if any circuit is found defective, spare circuit provided may be used temporarily.

Corrective action may then be taken to return all circuits to operating conditions.

6.5.3.4 Check the cable route and ensure that the route markers are in position.

6.6 Annual Checks

6.6.1 *Light Fittings*

6.6.1.1 Remove the fittings to store in groups and provide in their place new fittings from store to avoid absence of light in such places. Dismentle the fitting into its various components and clean them. Check the electrical parts such as connections leads, terminations, etc, and replace the worn-out damaged components before reassembly. Check and replace all gaskets on a leaky light units with new gaskets.

Paint all the fittings externally with aviation yellow (No. 356 of IS : 5-1978[*]). Paint in order to prevent them from rusting. The fitting numbers on the body of fittings should also be remarked.

6.6.2 *Additional Check for VASI Units*

6.6.2.1 Check the actual elevation setting of the units by means independent of the checking stick, that is, clinometer or theodolite. Check the levels of all units and checking stick plinths with a surveyor's level and verify that checking sticks still give valid indications.

6.6.3 *Constant Current Regulators*

6.6.3.1 Clean the interior assemblies of the regulator other than oil filled types.

6.6.3.2 Where moving coil type regulator is used, take out oil sample and test according to the recommendation of IS : 1866-1983[†]. Filter or replace, depending upon test results.

6.6.3.3 Check for cracked or broken porcelain and replace, if necessary.

6.6.3.4 Check label markings on control panel, etc.

6.6.3.5 Replace defective bushings.

6.6.3.6 Visually check regulator for burnt relay contacts, burned insulation and loose connections. If contacts are burnt or pitted completely, they should be replaced. If they are slightly pitted or dirty, clean them. Realign the contacts before fitting.

6.6.3.7 Make a dielectric strength test of the oil. Take one litre of oil sample through oil sampling valve at the base of regulator tank. If the oil is dirty or the dielectric stength is low, it should be replaced or filtered and dried to restore its dielectric strength. Sludge deposits on the core and coil assembly, and in the tank should be washed out with clean dry oil, fill with the oil to proper level.

6.6.3.8 *Short-circuit test* — Make a short-circuit test as follows:

a) Turn off power to regulator;

b) Short the output terminals with wire of minimum 2·5 mm^2 size;

c) Turn on the regulator and advance intensity through each step;

d) Read the output current on each step, the output current should be within limits:

Type	*Limits*
20 A 5 Step	19·5 -20·5
	15·41-16·2
	12·09-12·71
	10·54-10·56
	8·29- 8·71
8 A 5 Step	8·05- 8·43
	6·30- 6.70
	4·95- 5·25
	4·17- 4·43
	3·59- 3·81
6·6 A 5 Step	6·47- 6·7
	5·07- 5·33
	4·00- 4·2
	3·22- 3·49
	2·73- 2·87
6·6 A 3 Step	6·4 - 6·8
	5·34- 5·67
	4·66- 4·97

e) If the current output is not within limits, check if input voltage is within 15 percent of rated voltage;

f) Turn off the regulator; and

g) Disconnect short and reconnect output cables.

6.6.3.9 *Open circuit test* — It should be performed as given below:

a) Turn off power to regulator,

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[*] Colours for ready mixed paints and enamels (*third revision*).

[†] Code of practice for maintenance and supervision of mineral insulating oil in equipment (*second revision*).

b) Disconnect cables from output terminals,

c) Turn on power,

d) Advance brightness selector switch to any step,

e) Open circuit protective device should turn off the regulator within 2 seconds,

f) Repeat steps (c) to (e) for all brightness steps, and

g) Turn off the regulator supply and reconnect the output cables.

6.6.4 *Isolating Transformers* — Measure the insulation resistance of secondary of isolating transformers. If the insulation resistance is less, replace the transformer unit.

6.6.5 *Underground Cables*

6.6.5.1 Check condition of compound in cable end boxes, wherever accessible. Check cable insulation.

6.6.5.2 Check terminations of cables and renew tappings.

6.6.5.3 Check circuit marking number tabs and renew, if required.

6.6.5.4 Check terminations of multicore cables in thimbles and renew tapping. Replace thimbles required but cutting of strands should not be resorted to.

6.7 Though the schedule for maintenance given above is to be followed throughout the year, certain additional checks are necessary before and after monsoon as outlined below.

6.7.1 *Pre-monsoon Checks*

6.7.1.1 Check cable ducts and manholes for proper drainage of water.

6.7.1.2 Test cables with HT megger and look for any weak points. Joints may be repaired if required.

6.7.1.3 Check that the drain hole in the fitting is clear.

6.7.1.4 Check soundness of gaskets below the lens and base plate of fittings.

6.7.1.5 Point the inside portion of the cast iron box with bitumen.

6.7.1.6 Check tightness of the fixing bolts of the fittings.

6.7.2 *Post-monsoon Checks*

6.7.2.1 Open out the manholes of cable runs and the cast iron box of fittings. Remove collected water, if any, using manually operated pumps and after drying, cover up as before.

6.7.2.2 A general overhauling of equipment should be carried out every four years in the manner as may be prescribed by the manufacturers.

6.8 Maintenance of Other Miscellaneous Airport Lightings

6.8.1 *Earthing System*

6.8.1.1 Check all lighting system connections for tightness and check the earthing system to determine that the designed resistance to ground is maintained.

6.8.2 *Obstruction Lights*

6.8.2.1 Replace all the obstruction lamps at regular intervals after they have been in operation for 75 percent of their normal life. The lights should be checked daily for burntout lamps and broken lenses.

6.8.2.2 Check the lamp voltage at the lamp socket to ensure that the rated lamp voltage corresponds to (or is within 3 percent higher than) the average voltage across the lamp during the normal hours of operation and provides satisfactory output. Clean all lenses, reflectors and clean out the fixtures.

6.8.2.3 Obstruction lights installed at an overall height greater than 45 m above ground or water, if so situated, shall be controlled by a light sensitive device or shall operate continuously. Check each light sensitive control device to ensure that it will turn on at about 3 lux and turn off at about 8 lux when oriented towards a north sky light intensity. Under normal conditions, either a light sensitive control device or an automatic time control switch may be used to control the construction lighting.

6.8.2.4 The obstruction light should be checked for all cracked or broken lenses and these should be replaced. Check the fixtures for serviceability and cleanliness. Check control relays for proper operation, condition of contacts and electrical connections. Check condition of mountings (poles, towers, columns, etc). Take required corrective action.

7. MEASURES TO DEAL WITH FAILURE OF GROUND LIGHTING

7.1 The failure of lights to come up may be due to a variety of reasons such as:

a) supply failure to the control equipment;

b) defective control equipment;

c) open circuit in the cabling;

d) short-circuit in cables; and

e) earth faults (occuring usually in cable terminations, isolating transformers and the cable proper).

While the causes of failure of incoming supply to regulator could be easily dealt with as in the case of internal electrical installation, defects in control equipment could be checked in a sequential order as below:

> With the series circuit connected to the regulator, turn the control switch on. The operation of open circuit protection relay would indicate an open circuit in the load circuit and no fault in the regulator. The regulator should be switched on only after attending to the open circuit fault.
>
> On the other hand, tripping of input contactor would indicate defect within the regulator. Possible defects in a regulator are indicated below:
>
> a) Defective overload relay or open circuit relay,
>
> b) Defective contactors or selectors,
>
> c) Fuse failure, and
>
> d) Puncture of condenser.

Check these components, locate the defect and rectify/replace.

7.2 Locating Open Circuits in Series Cables — The method for locating the fault location of an open circuit fault in the series circuit cable is indicated below:

a) Switch off power supply to regulator and attach a danger plate to prevent accidental closing.

b) Disconnect one end of cable from regulator and connect it to the station earthing bus bar.

c) Half way down the circuit, megger the earthed half of the cable, conductor to earth (megger) high insulation reading will indicate that the open circuit fault is on that portion of the cable (that is, earthed side of the circuit). Zero reading will indicate that the fault is in the portion of the cable which has not been earthed.

d) Megger again half way down the faulty section. Eventually the fault position will be narrowed down to a cable length connecting two adjacent lamp fittings.

e) Examine both ends of the cable to ensure that the cable connections to the isolating transformers are sound. Replace the cable, if necessary.

f) Remove the earth from the cable at regulator and restore power supply.

g) Record the fault report.

NOTE 1 — An alternate method of shocking open circuits is as follows:

Disconnect the output terminals of the CCR after switching off the input supply. Loop out the two cable ends and connect to the live wire of a 230 V supply. Check the presence of voltage by test lamp at various locations (cable to ground). Absence of supply would indicate the location of open circuit.

NOTE 2 — It is possible to make use of a search coil/detector or capacitance bridge to locate open circuit faults. The method of search coil/detector, however, is open to inaccuracies due to the signal being picked up by adjacent cables and carried across the fault. Reasonably, reliable results may be obtained on more isolated airport lighting circuits of smaller airports.

7.3 Locating Earth Faults in Airport Cables — The type of earth faults occurring in an airport cable installation can broadly be classified as:

a) Earth fault at two or more locations,

b) Earth fault at one location, and

c) Low insulation resistance to earth.

The method of locating these faults is outlined below.

7.3.1 *Earth Fault at Two or More Locations*

a) In case of such a fault, the section(s) of circuit between the earth faults will be bridged out by a low resistance to earth. Depending upon the fault resistance, lamps in the section(s) may go out or appear dim. Inspect the section(s) in which lights are off or dim. Replace the first and last lamps to ensure that the fault is not due to lamp failure. (This check is particularly intended for smaller sections of failure involving say 2 or 3 lamps.) Switch off supply to CCR and attach a danger plate to prevent accidental closing.

b) Lift out the isolating transformer supplying the first lamp off/dim from its base casting, and visually inspect the same for any sign of insulation failure or absorption of moisture in the rubber moulding. Place the isolating transformer on a rubber mat or a piece of dry timber. Disconnect the earth wire from the transformer casing and measure insulation resistance from HT terminal to the casing. Low insulation reading will indicate that the short-circuit to earth is due to faulty transformer.

c) If the first transformer is not defective, check the adjacent transformer (supplying the last lamp normal) as described above and if this transformer is also not defective, the earth fault will be found in the cable connecting the two.

d) Disconnect the cable and check the insulation resistance of the cable alone.

e) To determine the locations of second short repeat step (a), (b) and (c) for transformer supplying the last lamp off/dim and first lamp normal and cable connecting the two.

f) Replace defective transformers and/or cable with new ones.

g) Check insulation resistance to earth of the complete circuit after necessary repairs have been made.

h) Record the fault report.

7.3.2 *Earth Fault in One Location* — With single earth fault, the lamps will be burning normally and, therefore, in the monthly schedule of maintenance test for this fault should be invariably carried out to prevent sudden failure of the system with the development of a second fault.

a) Switch off power supply to regulator.

b) Earth one of the cable ends by connecting it to the station earth bus bar (without disconnecting it from CCR).

c) Select 100 percent brightness in regulator and switch the power on and note the last lamp out (or dim) in the circuit (only if the fault resistance is less than about 1 000 ohms, a difference in lamp brillance will be observed). If the fault resistance is higher (as in earth leakage), a cable and farthest from the fault should be earthed to achieve higher voltage between the two earth connections, with subsequent larger earth current. Hence, if there is no difference in lamp brightness, the earth connection from the first cable end should be removed and second cable end should be earthed, and the test repeated.

d) Switch off power supply to regulator and attach a danger plate to prevent accidental closing.

e) Remove earth connection from the cable at the CCR room.

f) Lift out the series isolating transformer supplying the last lamp out (dim) from its base casing and visually inspect the same for any sign of insulation failure or absorption of moisture in the rubber mould. Place the isolating transformer in a rubber mat or a piece or dry timber. Disconnect the earth wire from the transformer casing and measure insulation resistance from HT terminal (or load) to the casing. Low insulation reading will indicate that short-circuit to earth is due to faulty transformer.

g) Should the condition of the transformer in question be good, check the condition of the same circuit in the adjacent fitting which is normal in the same way as described in (f).

h) If the condition of both the transformers is good, short-circuit to earth will be found in the cable connecting the two. Disconnect the cable from both the transformers and check the insulation resistance of the cable alone.

j) Replace defective transformers or cable with new one.

k) Check insulation resistance of entire circuit and restore power supply.

m) Record the fault report.

7.3.3 *Low Insulation Resistance to Earth* — When the cable insulation resistance to earth is within the range of 1 000 to 100 000 ohms at one location, the appropriate approximate position of the fault may be found by varely loop HT cable fault locator method, which calls for a bridge megger for testing.

NOTE — This method, though very reliable for power circuits, may not give accurate position of fault as resistance of series circuit includes contact resistance of the mating parts of plug and receptacle, and may even give misleading results.

APPENDIX A

(*Clause* 4.10.3)

PREVENTIVE MAINTENANCE SCHEDULE

A-1. DAILY CHECKS

Lighting System : Approach/Runway/Taxiway and Apron/VASI

Sl No.	*Items to be Checked*	*Dates of Month*									
		1	2	3	4	5	6	7	8	9	...31
	Light Fittings										
1.	Check for lamps not burning										
2.	Check for dimly burning lamps										
3.	Check failure of part or whole of circuit										
4.	Visually examine for damages and displacement of fittings and broken lens										
5.	Check for fixture out of alignment. Record the fixture location and correct at the earliest possible										
6.	Additional check for monsoon:										
	a) Visually check for evidence of lightning strike										
	b) Dry out water, if any, present in cast iron box of any of the damaged fittings. Paint such cast iron boxes black with insulating varnish										
	c) Check for grass, dirt and weeds around lighting units										
7.	Additional check for new VASI installation:										
	a) Check approach angle of VASI										
	b) Check that there is no obstruction in the light path										
	Constant Current Regulators										
1.	Clean CCR externally after switching off supply										
2.	Check for noiseless operation of regulator in steps										
3.	Check regulator for operation of all steps of brightness on remote control										
4.	Check back indication lamps of CCR										
	Remarks										

NOTE 1 — The records for the maintenance checks should be maintained separately for each lighting system, namely, approach lighting system, runway lighting system including threshold and turning pad lights (one for each runway circuit), taxiway and apron lighting system (one for each taxiway circuit), etc.

NOTE 2 — On completion of the maintenance checks, the respective columns should be ticked and wherever some replacements/repairs are carried out, their number should be indicated below and 'tick' mark and details of replacements recorded in the Replacement Register.

A-2. WEEKLY CHECKS

Lighting System : Approach/Runway/Taxiway/VASI

Items to be Checked | *Date and Fitting No.*

Lighting Fittings

1. Clean dirty lens externally with duster. Look out any crack in lens or filter
2. Check clips, screws holding the lens for
3. Check for vegetation growth. Remove it, if any
4. VASI

   Check aiming angle with aiming device

Serial No. of the fittings checked in the particular system should be indicated under the heading 'Fitting No.' above.

Note 1 — The records for the maintenance checks should be maintained separately for each lighting system, namely, approach lighting system, runway lighting system including threshold and turning lights (one for each runway circuits), taxiway and apron light system (one for each taxiway circuit), etc.

Note 2 — Serial numbers of the fittings checked in a particular system should be indicated under the heading 'fitting numbers' above.

Note 3 — On completion of the weekly checks for complete installation, a firm line should be drawn on that date so that the particular week could be distinguished from others.

Note 4 — On completion of the maintenance checks, the respective columns should be ticked and wherever some replacements/repairs are carried out, their number should be indicated below the 'tick' mark corresponding to the check concerned and details of replacements recorded in the Replacement Register.

A-3. MONTHLY CHECKS

Lighting System : Approach/Runway/Taxiway and Apron/VASI

Name of Month	*Items to be Checked*	*Light Fittings*		*VASI*				*Constant Current*		*Regulator*	*Underground Cables*		*Remarks*
		Check base plate bolts and tighten, if required	Air borne inspection of approach and edge lighting	Check mechanical parts for cleanliness	Check mechanical parts for chipping, bending and serviceability of threads	Check condition of plug and connectors	Clean optical surfaces like lamp filters with a suitable cleansing agents	Check oil level and oil leakage (for oil filled regulators only)	Check contactor panel for abnormalities that is, heating, chattering, etc	Check the operation through all stages of brightness using local control	Check the cable circuit insulation by megger and record value	Check such circuit for any single earth fault	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)

Fitting No.

Date

1
2
3
:
:
31

NOTE 1 — The records for the maintenance checks should be maintained separately for each lighting system, namely, approach lighting system, runway lighting system including threshold and turning pad lights (one for each runway circuit) taxiway and apron lighting system (one for each taxiway circuit), etc.

NOTE 2 — Serial No. of the fittings checked in a particular system should be indicated under the heading 'Fittings No.' above.

NOTE 3 — On completion of the maintenance checks, the respective columns should be ticked and wherever some replacements/repairs are carried out, their number should be indicated below the 'tick' mark corresponding to the check concerned and details of replacements recorded in the Replacement Register.

NOTE 4 — Take necessary remedial action in case the progressive deterioration is noticed.

A-4. QUARTERLY CHECKS

Lighting System : Approach/Runway/Taxiway and Apron/VASI

Items to be Checked	*First Quarter*		*Second, Third and Fourth Quarter*	
	Date	Fitting No.	Date	Fitting No.
Light Fittings				
1 (a) Check for presence of water in transformer boxes by removing the fitting. Remove water, if any				
(b) Replace water tight squeeze arrangement or fitting gasket, if deteriorated				
(c) Grease base plate bolts before refixing the fitting				
2 (a) Check connections of plugs and sockets with isolating transformer leads				
(b) Renew old tapes with PVC tapes				
3. Remove lens and filters, etc, and wash with suitable cleansing agent				
Control Panel				
Check for loose components and connections, and tighten them, if necessary				
Underground Cables				
1. Check earth resistance of cables with 500/1 000 V megger				
2. Check insulation resistance of feeder cables with megger				
3. Visually examine cable ends for any moisture entry in the sheathing				
4. Check earth resistance on CI boxes by megger				
Remarks				

NOTE 1 — The records for the maintenance checks should be maintained separately for each lighting system, namely, approach lighting system, runway lighting system including threshold and turning pad lights (one for each runway circuit), taxiway and apron lighting system (one for each taxiway circuit), etc.

NOTE 2 — Serial No. of the fittings checked in a particular system should be indicated under the heading 'Fitting No.' above.

NOTE 3 — The quarterly checks should preferably be carried out in the months of January, April, July and October.

NOTE 4 — On completion of the maintenance checks, the respective columns should be ticked and wherever some replacements/repairs are carried out, their number should be indicated below the 'tick' mark corresponding to the check concerned and details of replacements recorded in the Replacement Register.

A-5. HALF YEARLY CHECKS

Sl No.	*Items to be Checked*	*May Date*	*November Date*
	Elevated Light Fittings		
1.	Clean units inside and out, paint, if necessary		
2.	Realign, check all electrical connections		
3.	Check angle of elevation of approach light		
4.	Check structures for integrity of approach lights		
5.	Check approach area for new obstruction of approach light		
	Constant Current Regulators		
1.	Check for any pittings or burning of contacts of contactors, rotary switches. Clean the contacts, if necessary, with liquid N3 or carbon tetrachloride		
2.	Lubricate the bearings, if any, of contactors or rotary switches		
3.	Check the relays and contactors for proper functioning		
4.	Check the contacts of relays		
5.	Check the relay rockerarms for free movement and spring tension		
6.	Check mechanical and electrical interlocks, if any, for proper functioning		
7.	Check wiring and terminations		
8	(a) Check open circuit protection device for proper functioning		
	(b) Clean and adjust the dashpot of open circuit protection (for moving coil only)		
9.	Check open circuit protector with load disconnected		
10.	Test the earthing of CCR by megger		
	Underground Cables		
1.	Clean the manholes		
2.	For multicore control cable, perform megger test and record insulation resistance		
3.	Check cable route to ensure route makers in position		

Remarks :

NOTE 1 — The record for the maintenance checks should be maintained separately for each lighting system, namely, approach lighting system, runway lighting system, threshold and turning pad lights (one for each runway circuit), taxiway and apron lighting system (one for each taxiway circuit), etc.

NOTE 2 — On completion of the maintenance checks, the respective columns should be ticked and wherever some replacement/repairs are carried out, their number should be indicated below the 'tick' mark corresponding to the check concerned and details of replacement recorded in the Replacement Register.

A-6. ANNUAL CHECKS

Lighting System : Approach/Runway/Taxiway and Apron/VASI

Sl No.	*Items to be Checked*	*Date*	*Fitting No.*	*Date*	*Fitting No.*
	Lighting Fittings				
1.	Remove the fittings in groups and replace new ones from store				
2.	Dismentle the fittings and clean them. Replace the worn out/damaged parts before reassembly				
3.	Paint all fittings removed externally. Re-mark the fitting No. on body of the fitting				
	Check actual elevation setting by clinometer or theodolite				
	Constant Current Regulator				
1.	Clean the interior assembly of the regulator (other than oil filled type)				
2.	Test the oil sample. Filter or replace depending on results (for moving coil type CCR)				
3.	Check for cracked or broken porcelain				
4.	Check label markings for legibility				
5.	Check and replace defective bushing				
6.	Perform a short-circuit test and open circuit test				
	Isolating Transformer				
	Measure the insulating resistance of secondary of isolating transformer (if resistanceless, replace the transformer unit)				
	Underground Cables				
1.	Check condition of compound in cable and boxes				
2.	Check termination of cable and renew tapings				
3.	Check circuit marking number tags and renew, if required				
4.	Check thimbles of multicore cable and renew tapping replace thimbles, if required				

Remarks :

NOTE 1 — The records for the maintenance checks should be maintained separately for each lighting system, namely, approach lighting system, runway lighting system including threshold and turning pad light (one for each runway circuit), taxiway and apron lighting system (one for each taxiway circuit), etc.

NOTE 2 — Serial No. of the fittings checked in a particular system should be indicated under the heading 'Fitting Nos.' above.

NOTE 3 — On completion of the maintenance checks, the respective columns should be ticked and wherever replacements/repairs are carried out, their No. should be indicated below the 'tick' mark and details of replacement recorded in the Replacement Register.

A-7. ADDITIONAL PRE-MONSOON AND POST-MONSOON CHECKS

Sl No. *Items to be Checked*

Pre-monsoon Checks

1. Check cable ducts and manholes for proper drainage of water
2. Test cables with HT megger and look for any weak points
3. Check that the drain hole in the fitting is clear
4. Check soundness of gaskets below the lens and base plate of fittings
5. Paint the inside portion of the CI box with bitumen
6. Check the tightness of the fixing bolts of the fitting

Post-monsoon Checks

In addition to the checks (2) and (3), open out the manholes of cables runs, and the CI box of fittings. Remove collected water, if any, using manually operated pumps and after drying, cover up as before

Remarks :

APPENDIX B

(*Clause* 4.10.3)

PROFORMA FOR REPLACEMENT REGISTER

Name of System : Approach Lighting/Runway Lighting/Taxiway and Apron Lighting/VASI

Sl No.	*Date*	*Lamp*	*Filter*	*Lens*	*Fitting* (Give Fitting No.)	*Isolating Transformer*	*CCR Name of Component*	*Cables*	*Make of Defective Item Replaced*	*Reasons for Replacement*	*Date When Last Replaced*	*Any Other Remarks*

NOTE 1 — A separate Replacement Register should be maintained for each system.

NOTE 2 — Each register should give the details of costs of various components on the first page and should be periodically updated.

Component	*Date*	*Cost*	*Date*	*Cost*

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